A Recipe for Delicate Size Control of nZIF-8: The Ionic Liquid Microemulsion Method

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As the world is accelerating toward an aging society in the 21st century, the demand for advanced medical technologies is rising, notably in the field of pharmaceuticals employing nanomaterials, expected to surge by 218% from 2023 to 2032. Among these, nano Metal-Organic Frameworks (nMOFs) have gained attention for their structural stability and large surface area, promising various biomedical applications. However, precise size control is crucial to ensure effective utilization without adverse effects on the body. But the common synthesis methods like solvothermal or microwave-assisted methods have limited the application of nMOFs due to difficulty in controlling the size in nanoscale despite their many advantages. So we focused on ionic liquid microemulsion method (ILME) as a solution to this challenge. It is a method in which nMOFs are synthesized in micelles formed by two immiscible ionic liquids and a surfactant. Using the method, we created a brand-new recipe which finely controls the particle size of ZIF-8, a typical type of nMOF, by changing the condition of microemulsion components. In our project, only ZIF-8 was synthesized under new conditions where the types of halide in ionic liquid and surfactant varied. Then we found ZIF-8 with various particle sizes were produced by changing the factors with consistent tendency. Also, the ternary phase diagram of our new system was created to obtain the proper conditions for composition ratio of the microemulsion components for ILME synthesis and to control the size of ZIF-8 by changing the ratio. As a result, we synthesized ZIF-8 of a range 20 nm ~ 60 nm with a delicately controlled interval about 5 nm by changing the factors. So we expect that our recipe will take credit for utilization of nMOFs including biofields.

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